Bruce C. Heezen Graduate Research Fellowship

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LONG-TERM GOALS

Provide the nation with the highest quality expertise in marine geology and geophysics research capabilities, specifically in areas that are of current interest to the Office of Naval Research.

OBJECTIVES

Select and support an outstanding graduate student carrying out research of interest to the Office of Naval research

APPROACH

The Bruce C. Heezen Graduate research Fellowship will be awarded to an outstanding graduate student whose research focus is marine geology and geophysics, and who is a U.S. citizen or permanent resident. The student is identified each year from among the Lamont student body, the criteria for selection of the successful candidate combining consideration of scientific excellence and the field of research, with emphasis upon fields of current interest to the Office of Naval research.

WORK COMPLETED

Kori Newman graduated from Smith College in May 2003 and has just completed her second year as a graduate student in Department of Earth and Environmental Sciences at Columbia University under the mentorship of Professor William Menke. Her current research topic, a description of which follows, is entitled:

'Investigating methane venting along the U.S. mid-Atlantic shelf edge using the Autonomous Underwater Vehicle (AUV) SeaBED'

A series of en echelon seafloor pockmarks observed by Driscoll et al. (2000) were hypothesized to be evidence of slope instability. Sidescan and high resolution seismic (chirp) data collected during a May 2001 cruise aboard the R/V Cape Hatteras revealed the features are not fault related but rather are a series of large gas blowouts (Hill et al., 2004). A second cruise was conducted in July 2004 to

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investigate current gas venting in the area. The SeaBED AUV, equipped with a METS methane sensor and CTD, was deployed in the blowouts to determine if methane is actively being released near the blowouts. Color photographs of the seafloor were also continuously collected during the SeaBED dives, but have not yet been analyzed in detail. In addition to the SeaBED missions, a new, high resolution, bathymetric map was produced during the cruise. Numerous cores were collected; half were squeezed for pore water geochemistry to determine the source, biogenic or thermogenic, of the methane while the other half were saved for stratigraphy and possible dating of the blowouts' age. A few hydrocasts were also performed to determine if methane is present throughout the water column and if its source is the same as the vented methane. All cores and water samples are being analyzed at SIO.

Analysis of the METS data yields several significant results. A strong negative correlation is observed between dissolved methane concentration and temperature and salinity, showing that the methane-rich vent fluids are likely colder and less saline than the surrounding shelf water. This may be the result of dissociation of offshore gas hydrate. In addition, sharp salinity and temperature gradients are present in the data, allowing a further understanding of the response of the METS sensor to be achieved. Previously, others observed that a lag exists in the METS data, but the exact nature of the lag was not known. Using the relationship between dissolved methane and temperature, the response of the sensor can be deconvolved. The result of this work is that the response of the sensor can be represented as the exponential function that describes diffusion across a membrane, a process present in the METS sensor. From this an algorithm has been constructed to correct the METS sensor response using the finite difference equation, $x(t_n)=y(t_n)+[y(t_{n+1})-y(t_n)]/(1-e^{-\Delta t/\tau})$, where $x(t)$ is the true signal, $y(t)$ is the signal reported by the METS sensor, Δt is the time interval between measurements, and τ is the system time constant which this study has determined to be about 11 minutes.

Using corrected dissolved methane concentration data the spatial distribution of methane can be mapped (Fig. 1). In general high methane is observed on the blowout walls and on the adjacent shelf areas outside the blowouts. Methane is not observed on the floors on the blowouts. This is consistent with the results of Hill et al. (2004) where the chirp profiles show abundant gas along the walls of the blowouts, extending east, with no gas present beneath the floor of the blowouts. Further work needs to be done to determine if diffuse venting is occurring at all locations methane is observed, or if localized venting is occurring with the methane being transported around the survey area by currents.

Initial results from the 2004 cruise were presented at the 2004 Fall AGU meeting and an abstract will be submitted for the 2005 Fall AGU meeting. A manuscript for publication is also being prepared. In addition, in July 2005 twelve teachers from New York and New Jersey participated in a two-day curriculum development workshop that focused on material related to the July 2004 cruise. Further information about the workshop can be found at www.earth2class.org/er/conferences/gas%20blowout%20summary.php.

Driscoll, N.W., J.K. Weissel, and J.A. Goff (2000), Potential for large-scale slope failure and tsunami generation along the U.S. mid-Atlantic coast, *Geology, 28*, 407-410.

Hill, J.C., N.W. Driscoll, J.K. Weissel and J.A. Goff (2004), Large-scale elongate gas blowouts along the U.S. Atlantic margin, *J. Geoph. Res., 109*, B09101, doi:10.1029/2004JB002969.

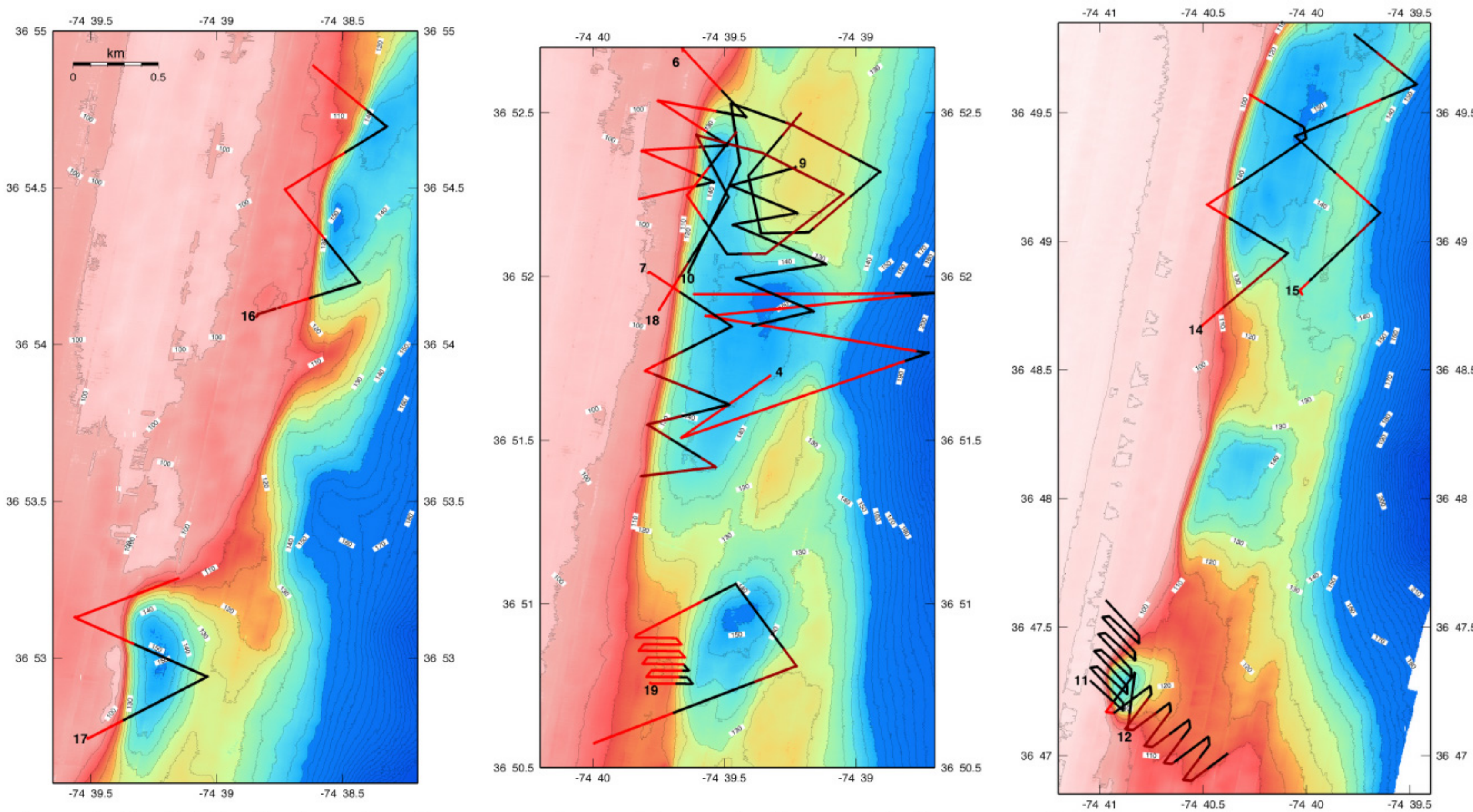

Figure 1. Spatial distribution of methane anomaly overlain on the blowouts' bathymetry. The data have been grouped into three categories: bright red indicates areas of high dissolved methane, black of background (little to no) methane, and dark red or elevated methane. Dive numbers are given at the start of each track.